Stephen Morse

from John Pyles
Leslie Salt

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not Appendices

LESLIE SALT COMPANY

Report on Proposed Discharge of Bittern Through South Bay Dischargers Facilities

June 27, 1975

CDM Inc., ENVIRONMENTAL ENGINEERS
Pasadena, California

CDM Inc. ENVIRONMENTAL ENGINEERS

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June 25, 1975

Mr. Guy Wilkins
Leslie Salt Company
7220 Central Avenue
Newark, California 94560

Dear Mr. Wilkins:

Enclosed is our report on the proposed discharge of bittern from the Leslie Salt Company through proposed outfall facilities of the South Bay Dischargers.

We look forward to participation in further discussions of the matter to the end that the proposal may become a reality at an early date.

Our deep appreciation is extended to the excellent assistance rendered by you and Mr. Roy Barner in the sampling and testing phases of the study and during the preparation of our report.

Very sincerely,

CDM Inc., ENVIRONMENTAL ENGINEERS

Robert H. Born
Executive Vice President

RHB:dq

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INTRODUCTION

The Leslie Salt Company is a consolidation of numerous salt production and refining enterprises, some of which were organized more than a century ago. Through the process of consolidation and regrouping, the companies were reduced in number over the years, plants were dismantled or were relocated and modernized, until by 1941, the Leslie Salt Company remained as the major crude salt production enterprise in the San Francisco Bay area.

The growth in crude salt production has been spectacular since 1907, when the Leslie Salt Refining Company was organized as the first company to bear the Leslie name. By 1936, when the present Leslie Salt Company was incorporated, between 300,000 and 325,000 tons of salt were produced each year from about 12,000 acres of ponds by two companies operating five plants. At the conclusion of World War II, the production had grown to nearly 500,000 tons per year. At present, Leslie Salt Company produces salt from approximately 44,000 acres of salt ponds and appurtenant lands in the Bay area with a total annual capacity of 1,250,000 tons by the process of solar evaporation. Except for more efficient methods of handling and transportation of the crude salt, this ancient process is still being utilized today.

As a by-product of the final stages of crude salt production, the Leslie Salt Company produces a liquor, or highly concentrated brine solution, termed bittern, which, until recently, had significant commercial value as a source of magnesium, bromine and gypsum salts. The recent loss of much of the historical market for its bittern, together with changes in Federal and State laws and regulations governing the discharge of bittern to San Francisco Bay, have caused Leslie Salt Company to investigate various alternative means of bittern disposal.

BACKGROUND

Leslie presently operates four crude salt plants in the San Francisco Bay area, the location of one of which, Plant No. 2, is shown on Figure 1. Each of the four plants is complete in itself and contains its own concentrating ponds, crystallizing ponds, harvesting equipment and a washer. Each of the plants can be operated as an independent unit although pipelines have been installed between the Baumberg and the Newark Plants as well as between the Redwood City and Newark Plants to facilitate the transfer of brine between plants for increased efficiency of pond utilization.

The salt production process is relatively simple yet time-consuming, in that five years are required to reduce the bay water to salt crystals. The bay water is pumped through a series of evaporation or concentrating ponds in stages over a four-year period during which the sun and wind evaporate the water and

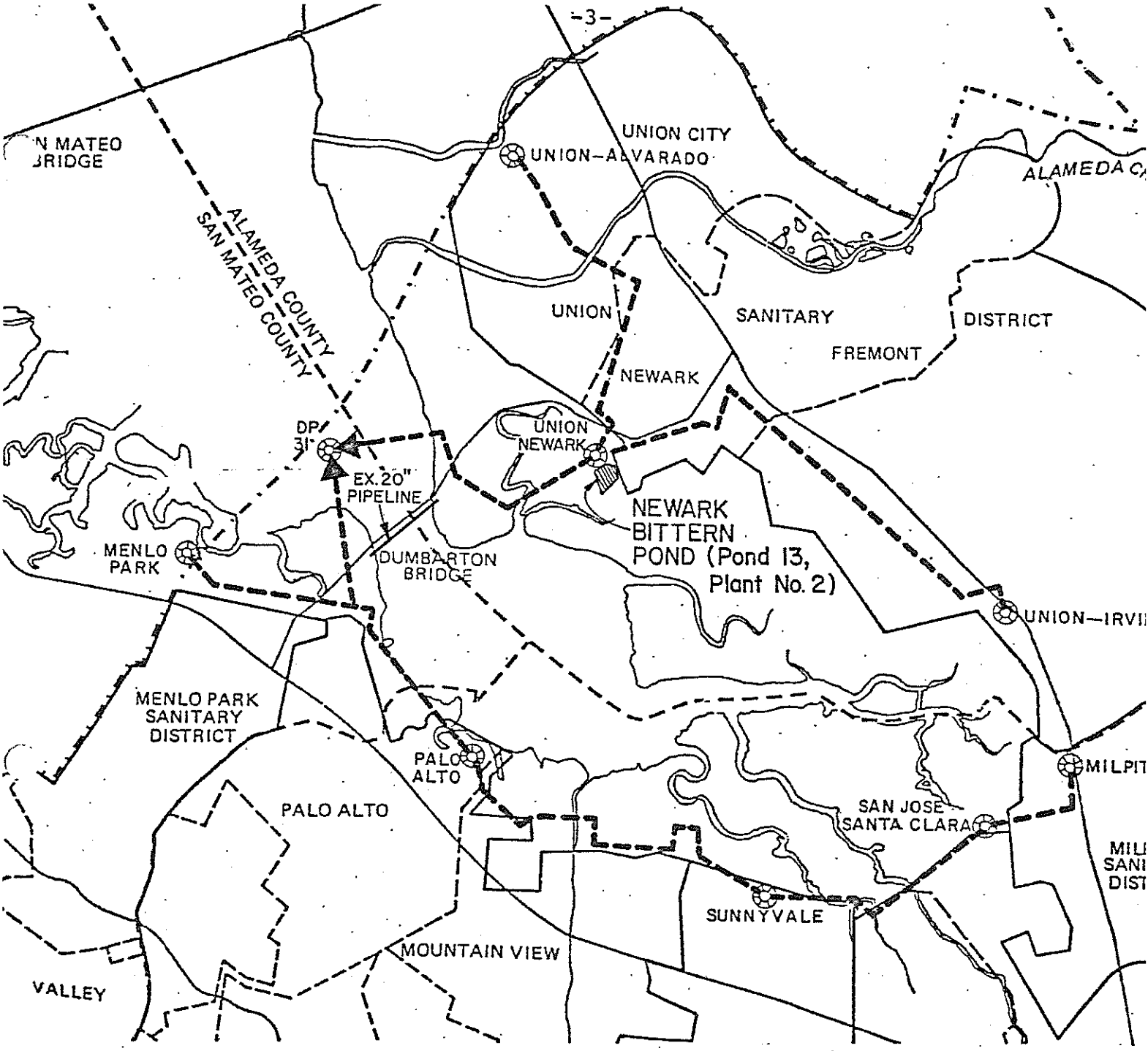

FIGURE 1

LOCATION PLAN

SHOWING BITTERN PONDS AND PROPOSED
SOUTH BAY DISCHARGERS OUTFALLS

1 1/2 0 1 2 3
MILES

NORTH

leave a highly concentrated brine solution. The concentration process takes place through a series of nine systems of ponds. By the time the brine has reached the ninth or so-called pickle pond, it has been reduced in volume to about 10 percent of the volume of bay water first taken in, and most of the gypsum has precipitated.

From the pickle pond, the brine is transferred to the crystallizing ponds where the sodium chloride crystallizes. Pickle enters at approximately 25.6°Bé and bittern is withdrawn at 29°Bé. The bittern is transferred to bittern ponds where continued evaporation raises the specific gravity to between 30° and 32°Bé, depending on the storage time. Depending upon the length of time in storage, the bittern reaches a maximum specific gravity of about 36°Bé, beyond which no evaporation takes place.

For every million tons of salt produced, 38.3 million tons of bay water are required, illustrating the tremendous volumes of bay water and brine that must be transported during the concentrating and evaporation process. One million tons of bittern are produced for each million tons of salt produced, also illustrating the magnitude of the bittern disposal problem.

Based on present production levels, slightly more than a million tons of bittern are produced at the three south Bay plants as shown in Table 1. These figures, when converted to

TABLE 1

CURRENT BITTERN PRODUCTION
FROM SOUTH BAY PLANTS

Plant	Thousands of tons/year
Newark	540
Baumberg	180
Redwood City	300
Total	1,020

flow indicate that a total of 201 million gallons per year (mgy) needs to be disposed of, including about 126 mgy from the east bay plants at Newark and Baumberg, and 75 mgy from the west bay plant at Redwood City.

The two previously used alternatives for bittern disposal no longer exist. For the foreseeable future, the bittern has no great economic value and its use as a source of certain salts other than sodium chloride is no longer of commercial significance to the Leslie Salt Company. Also, it was the practice in earlier years prior to the adoption of present water quality standards by the Federal and State governments to discharge the bittern directly to adjacent sloughs or shallower portions of San Francisco Bay near the bittern ponds. This practice is no longer acceptable because of the probable adverse environmental impact. Further, the cost to correct the probable damage to the marine environment from the former practice would be substantially greater than any other alternative.

One remaining alternative disposal method would be to store the bittern as is being done at present. The long-range utility of this method is questionable owing to the ever-increasing amount of land area that must be devoted to this purpose. Because the rate of bittern evaporation would not keep up with bittern production, increasingly greater acreages of land would be devoted to bittern storage and decreasing acreages of land would be

available for salt production. The reduced production of salt would eventually combine to result in an uneconomical and probable unprofitable salt producing enterprise, leading to the elimination of the Leslie Salt Company as a Bay area industry.

In addition to the economic restraints placed on Leslie through the loss of production acreage, there are other restrictions being placed on the use of evaporation ponds for bittern storage. For example, in a letter to the U.S. Environmental Protection Agency from the San Francisco Bay Conservation and Development Commission (BCDC) with regard to the economical and environmental importance of salt ponds in South San Francisco Bay, in scientific studies performed for BCDC in the preparation of the Bay Plan, a number of beneficial aspects of the ponds were identified; quoting from the BCDC letter: "The ponds provide 15 percent of the total Bay and pond surface. The water surface area moderates the Bay area climate, reduces smog, provides habitat for brine shrimp, shore birds, land water fowl, and adds open space to the area. The Bay Plan's policies on salt ponds recognizes this importance and states, in part 'As long as is economically feasible, the salt ponds should be maintained in salt production ... Property tax policy should assure that rising property taxes do not force conversion of the ponds ... to urban development. In addition, the integrity of the salt production system should be respected...'" Also included within the Bay Plan's policies are requirements that if any ponds are withdrawn from production, the public should make

every effort to buy these lands, breach the existing dikes, and reopen these areas to the Bay. Returning these lands to tidal action also represents the remaining opportunity to create new marsh in the Bay.

Conversion of existing salt ponds to storage areas for bittern would require a BCDC permit which would very likely be denied. This situation would place the Leslie Salt Company in a dilemna. As a result of the restrictions placed on Leslie discharging bittern directly to receiving waters or to storage, CDM Inc., ENVIRONMENTAL ENGINEERS was engaged to investigate specific means whereby bittern might be discharged directly to San Francisco Bay without causing harm to the biota of the Bay or otherwise violating applicable laws and regulations, and to prepare a comprehensive report thereon which could be used in support of subsequent applications by Leslie Salt Company for waste discharge permits from the Federal and State Governments.

The bittern disposal method studied in the above mentioned report was by a diffuser located in the vicinity of the Dumbarton Bridge. Extensive model tests were made of the proposed diffuser design to ascertain the optimum design, and to determine the impact of the discharge by this method on the receiving waters. It was determined by these tests and by laboratory analyses of the physical and chemical characteristics of both the diluted bittern and the bay water that there would be a minimal zone of toxicity created by the discharge.

The California Department of Fish and Game has evidenced great concern over the discharge of any toxic substances into marine and estuarine environments because of their potentially deleterious effects on both plant and animal life. These effects may be both short-term and long-range.

Of immediate concern is the direct toxic action toward a given species, commonly measured within a period of 96 hours or less and referred to as "direct" or "acute" toxicity. Of longer range concern, though by no means less significant, is the toxic action toward a species or its food chain, which may take place over periods of several weeks, months or years. The long range deleterious effects of such action are known as "chronic" toxicity.

The toxicity of bittern toward plant and animal life is a function of both time and concentration. For higher concentrations of bittern, its toxicity increases with continued exposure. As the concentration is reduced, a level is reached where the toxicity of the diluted bittern is not measurable or discernible from bay water, and the solution is neither acutely nor chronically toxic.

While many species of plant and animal life can survive for short periods within highly toxic environments with no observable deleterious effects, changes in growth rates, physiology, behavior patterns, reproduction capability and other vital functions may occur. Concern over these long-range effects, due to their

difficulty of measurement and the lack of sufficient published information on the subject, has caused regulatory agencies to adopt a somewhat cautious attitude with respect to both water quality standards and waste discharge requirements.

It is this concern that has led the California Department of Fish and Game to oppose the use of a diffuser at the Dumbarton Bridge as the bittern disposal method. Even though the zones of concentration in excess of a 100:1 dilution are very small, they still would exist and might possibly have some deleterious effect on the aquatic life which would pass through these zones.

With the use of a diffuser for all practical purposes ruled out, Leslie Salt Company is investigating the possibility of joining with the South Bay Dischargers in their proposed outfalls to Discharge Point 31 (DP31) approximately one mile north of the Dumbarton Bridge as shown previously in Figure 1.

ANALYSIS OF JOINING SOUTH BAY DISCHARGERS

The South Bay Dischargers consist of a joint powers agreement among the following tributary agencies:

- Menlo Park Sanitary District
- City of Palo Alto
  City of Mountain View
  City of Los Altos
  Los Altos Hills
- City of Sunnyvale

. Cities of San Jose and Santa Clara
  Burbank Sanitary District
  Cupertino Sanitary District
  County Sanitation District No. 2
  County Sanitation District No
  County Sanitation District No
  Sunol Sanitary District
. Milpitas Sanitary District
. Union Sanitary District
. Valley Community Services District
. City of Livermore

The South Bay Dischargers had a report prepared for them entitled "Water Quality Management Plan for South San Francisco Bay" by Consoer-Bechtel dated March 1972. This report is the basis for all of the data used in evaluating the possibility of Leslie joining in with the South Bay Dischargers. The recommended plan for the South Bay Dischargers consists of two independent and basically unrelated plans: the Bayside plan and the Livermore Valley plan. It is the former which will be addressed in this report.

The basic elements of the Bayside Dischargers plan are included on the previously presented Figure 1 and will be briefly summarized in the following text. The system consists of three major subregional treatment plants at Palo Alto, San Jose-Santa Clara, and Union-Newark, two outfall systems to a deepwater diffuser at DP 31 about one mile north of Dumbarton Bridge, plus interconnecting pipelines.

Major features of the proposed system include:

- Consolidation of the eight existing treatment facilities to three by about 1980.
- General upgrading of the level of treatment to include filtration and substantial nitrification.
- Expansion and improvement of facilities based on achieving required improvements in water quality at least cost.
- Export of wastewater out of the South Bay.
- Staged construction to meet short-term (10-15 year) requirements.

Under the proposed plan, the Bayside Dischargers are split into two separate groups, the easterly group consisting of the three Union Sanitary District treatment plants and the westerly group consisting of the remaining five treatment facilities. Each of the groups would have an independent outfall discharging to DP 31 with approximately 85 percent of the flow being in the westerly group. For the purposes of this study, it is assumed that Leslie would tie into the outfall on the westerly side of the bay downstream of the Palo Alto treatment facility. All subsequent information on flows, dilutions, costs, etc. is based on this assumption.

The major problem which has to be overcome before Leslie Salt Company can participate in the South Bay Dischargers' plan is an institutional one. The South Bay Dischargers should be impressed that this alternative is a viable solution and the most environmentally sound for all parties concerned. Through a series of

meetings between representatives of the South Bay Dischargers Board of Directors and of the Leslie Salt Company, an equitable solution for both parties should be found.

Assuming that the legal arrangements can readily be made, then the combined project must meet the water quality requirements as established in the San Francisco Bay Basin Water Quality Control Plan Report and in the NPDES Permits issued to the dischargers.

Within the above mentioned Basin Plan is a prohibition placed on the discharge of any wastewater which has characteristics of concern to beneficial uses into San Francisco Bay south of the Dumbarton Bridge. Exceptions will be considered when the discharge is approved as part of a reclamation project or where it can be demonstrated that environmental benefits will be derived as a result of the discharge. The southernmost segment of the Bay is identified as the most severely degraded of any within the Bay-Delta system and has the poorest bacteriological quality. These are a few of the reasons why the Basin Plan has endorsed the South Bay Dischargers plan.

In addition to the aforementioned restrictions, the southern extremities of the Bay do not presently meet minimum dissolved oxygen (DO) objectives, nor would the future conditions (year 2000 loads) meet DO objectives if municipal wastewater treatment

were limited to secondary level. In ascertaining the degree of treatment required to meet the DO objectives, the assimilative capacity of the receiving water segment in terms of Ultimate Oxygen Demand (UOD) is determined. For the South Bay segment, this was determined to be 140,000 pounds per day and the allowable UOD loads that can be discharged to DP 31 without violating water quality objectives are as follows:

Allowable Ultimate Oxygen Demand at DP 31

	1985	2000
Dry Period	86,000 lb/day	81,000 lb/day
Wet Period	80,000 lb/day	64,000 lb/day

These restrictions on discharges would be included in any NPDES permits issued for the proposed project. The San Francisco Bay Regional Water Quality Control Board (SFBRWQCB), which has jurisdiction over this project, would issue individual permits to the contributing agencies or one collective permit for the entire project depending on the strength of the Joint Powers Agreement made between the agencies. Under either case, Leslie Salt Company would have their own permit issued to them which would mandate their discharge requirements at the point which they join the outfall system. This permit would not be as restrictive as their existing NPDES Permit and would not require any dilution prior to joining the outfall.

By contributing their bittern to the South Bay Dischargers,

Leslie is able to meet the dilution requirements of the Department of Fish and Game. By including the average bittern flow of 0.55 mgd with the flows in the outfall downstream of the Palo Alto plant, considerable dilution is achieved. A summary of the projected flows and resulting dilution ratios is shown on Table 2. As may be noted, the minimum dilution ratio achieved, which is when the project is "on-line" in 1980, is 283:1. At certain times of day, the dilution might be less than this due to diurnal variations in the treatment plant effluent flow, however, corresponding adjustments could be made in the bittern flow level to maintain a relatively constant dilution. Up until 1980, it will be necessary to store additional bittern beyond that which has already been stored and it will be necessary to have a higher flow rate of bittern for a short period of time to dispose of the stored bittern. Maintaining a dilution ratio of 100:1 would allow a total bittern flow rate of 1.55 mgd. At this flow rate, it would take approximately four to five years to dispose of the bittern which would accumulate prior to the date the outfall system goes into service.

In order to determine what the minimum dilution ratio which is required to meet the discharge requirements with regard to toxicity and other limitations is, samples of bittern were diluted with effluent from Valley Community Services District in Pleasanton, California, and tests were run on the resulting solutions. Effluent from Valley Community Services District was selected as it was judged to be the closest approximation in character to the hypothetical combined effluent from the South Bay Dischargers tributary

TABLE 2

SOUTH BAY DISCHARGERS
OUTFALL CONTRIBUTIONS
(Flows in mgd)

CONTRIBUTOR	1970	1980[1/]	1985	2000
Sunnyvale	14.4	17.9	19.6	21.7
San Jose	72.0	97.7	110.5	152.5
Palo Alto	22.1	26.4	28.5	32.0
Menlo Park	5.7	7.2	8.0	9.4
Milpitas	2.8	6.2	7.9	12.0
TOTAL	117.0	155.4	174.5	227.6
DILUTION[2/]	213:1	283:1	317:1	414:1

1/ 1980 Flows are a straight line interpolation.
2/ Based on average bittern flow of 0.55 mgd.

plants. Both chemical analyses and bioassays were run on solutions varying from a dilution of 50:1 to pure diluent. A summary of these test results is presented in Tables 3 and 4. Copies of detailed test results are appended at the end of this report.

Theoretical UOD concentrations for the various dilutions were also calculated based on the following formula which was presented in the Basin Plan:

$$UOD = 1.5(BOD_5) + 4.6(NH_3\text{-}N)$$

A graph showing theoretical and actual UOD concentrations is presented as Figure 2. The maximum allowable UOD concentration was determined using the allowable UOD for 1985 of 86,000 pounds per day as presented previously. The resulting value of concentration based on this amount and the corresponding 1985 flow is 50 mg/l. As may be seen in Figure 2, there is no problem in meeting this objective. It should be noted that the TDS at all dilutions tested is less than bay water.

The other prime objective in diluting the bittern concentraiton, is to reduce the toxicity. As may be seen in Table 4, at a dilution of 100:1, only one test sample failed to achieve 100 percent survival after 96 hours. At all greater dilution ratios, there was 100 percent survival for each of the tests. These results indicate that the use of a 100:1 dilution as a minimum is very reasonable, especially considering that this dilution ratio would only be used during the time that the stored bittern is being disposed of. After the excess has been discharged, the bittern concentrations will be so low as to present no toxicity problem whatsoever.

TABLE 3

CHEMICAL ANALYSES SUMMARY

Sample[a] Dilution	Sample Date	B.O.D. ppm	C.O.D. ppm	U.O.D. ppm	Ammonia as N, ppm	S.S. ppm	T.D.S. ppm	Turbidity JTU
Diluent[b]	1-27-75	7	62	-	0.95	4	760	2.2
200:1	1-27-75	9	124	-	0.95	4	2836	2.5
150:1	1-27-75	10	133	-	0.95	4	3559	2.9
100:1	1-27-75	11	152	-	0.90	5	4889	3.2
75:1	1-27-75	12	171	-	0.90	6	6224	4.0
50:1	1-27-75	15	210	-	0.80	8	8881	5.0
1000:1	2-21-75	5	69	-	negl.	14	1300	6.7
Diluent[b]	2-25-75	5	37	-	1	5	860	4.2
1000:1	2-25-75	4	39	-	1	5	1300	3.9
Diluent[b]	3-25-75	4	38	9	0.24	3	772	3.3
250:1	3-25-75	6	75	11	0.24	6	2500	3.5
200:1	3-25-75	7	94	12	0.24	7	2970	3.5
150:1	3-25-75	7	123	13	0.30	7	3700	4.2
100:1	3-25-75	9	140	16	0.30	10	5170	4.2

[a] Samples were bittern from Pond 13, Plant No. 2 at approximately 35°Bé

[b] Secondary effluent from Valley Community Services District, Pleasanton, California

TABLE 4

BIOASSAY ANALYSES SUMMARY

Sample Dilution	Sample Date	24 hr Survival	48 hr Survival	72 hr Survival	96 hr Survival
Diluent	1-27-75	100%	100%	100%	100%
		100%	100%	100%	100%
		100%	100%	100%	100%
200:1	1-27-75	100%	100%	100%	100%
		100%	100%	100%	100%
		100%	100%	100%	100%
150:1	1-27-75	100%	100%	100%	100%
		100%	100%	100%	100%
		100%	100%	100%	100%
100:1	1-27-75	100%	100%	100%	100%
		100%	100%	100%	100%
		100%	100%	100%	100%
75:1	1-27-75	100%	90%	80%	80%
		100%	100%	90%	90%
		100%	90%	80%	80%
50:1	1-27-75	100%	50%	30%	30%
		100%	50%	20%	20%
		100%	50%	30%	30%
Diluent	3-25-75	100%	100%	100%	100%
		100%	100%	100%	100%
		100%	100%	100%	100%
250:1	3-25-75	100%	100%	100%	100%
		100%	100%	100%	100%
		100%	100%	100%	100%
200:1	3-25-75	100%	100%	100%	100%
		100%	100%	100%	100%
		100%	100%	100%	100%
150:1	3-25-75	100%	100%	100%	100%
		100%	100%	100%	100%
		100%	100%	100%	100%
100:1	3-25-75	100%	100%	100%	100%
		100%	100%	100%	90%
		100%	100%	100%	100%

Note: Test Species: Gasterosteus Aculeatus
Laboratory: Ray W. Hawksley Company, Inc.
Detailed test results are included in Appendix

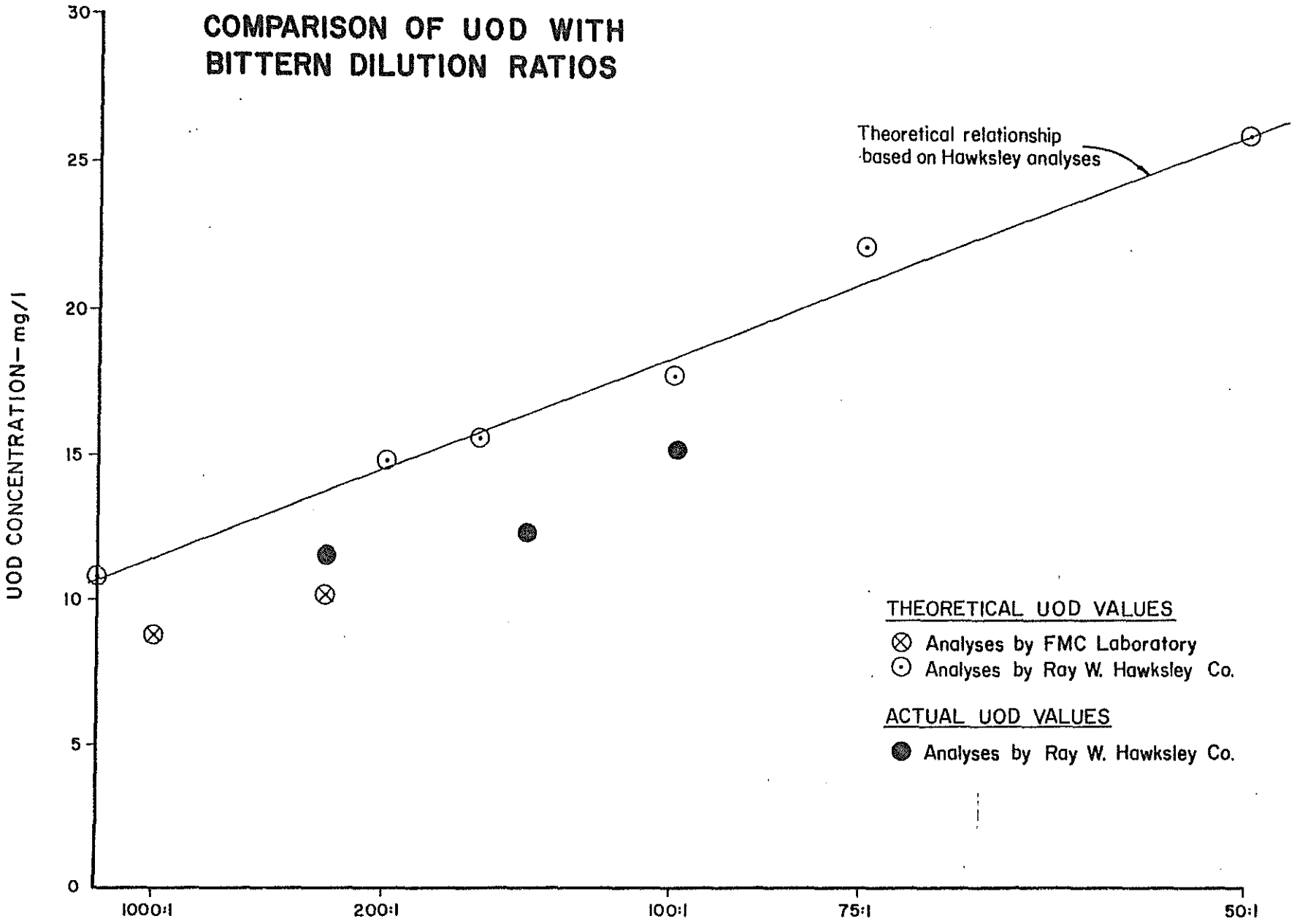
COMPARISON OF UOD WITH
BITTERN DILUTION RATIOS
Theoretical relationship
based on Hawksley analyses
UOD CONCENTRATION—mg/l
30
25
20
15
10
5
0
1000:1
200:1
100:1
75:1
50:1
DILUTION RATIO
(Diluent to Bittern)
THEORETICAL UOD VALUES
Analyses by FMC Laboratory
Analyses by Ray W. Hawksley Co.
ACTUAL UOD VALUES
Analyses by Ray W. Hawksley Co.

FIGURE 2

The financial impact on Leslie Salt Company of joining with the South Bay Dischargers is not as readily determined as is the quality impact. As stated in the South Bay Dischargers' Project Report, there are many factors which can be included in an allocation formula. Of those factors presented, the ones of concern to Leslie include:

- Average and peak flow
- Distance of discharges from disposal point
- Value of existing facilities which are included in the regional plan or which are retired because of regionalization
- Economics of scale due to any discharger's participation
- Value of new facilities required by recommended plan

It is necessary, in addition, to distinguish between fixed and variable cost elements. Thus an allocation formula for capital investment and capital-related annual costs (debt service and capital recovery accruals) must be relatively fixed in initial negotiation on the basis of projected entitlements to all facilities included in the plan, whereas annual operating, maintenance and administrative costs can be adjusted at frequent intervals on the basis of project experience. The only aspects of Leslie's contribution which have an effect on the cost of the regional system are the average and peak flow and these only apply to that portion of the system which is actually influenced by the addition of the bittern. Under the proposed plan, this amounts to the average and peak flows of 0.55 and 1.55 mgd, respectively, being discharged to the outfall downstream from the Palo Alto plant.

The peak flow of 1.55 mgd is not a true peak flow but is that flow rate which will be in use during the disposal of the stored bittern. In analysis of shared costs, this value will be used as a peak flow.

The State Water Resources Control Board has suggested various treatment plant loading parameters for use in allocating costs for each unit process for both operating and capital expenses. General overhead and administrative costs are difficult to allocate to specific elements of the sewerage system. It is acceptable to pro-rate these costs among the categories of users in proportion to their respective share of other operating expenses.

SUMMARY

The most difficult problem to be resolved in implementing a merging of the Leslie Salt Company bittern discharges with the South Bay Dischargers' westerly outfall remains to be the institutional question. An arrangement equitable to all parties involved should be resolved through meetings between Leslie and the Board of Directors of the South Bay Dischargers. Without a satisfactory agreement, the Leslie Salt Company may be forced to abandon their salt production operation in the South Bay area. Such an action would result in the irretrievable loss of a valuable wildlife preserve which the evaporation ponds have become.

This final option open to the Leslie Salt Company is also the most environmentally sound alternative for bittern disposal. Not only are the evaporation ponds maintained for a wildlife

preserve; the bittern is also diluted sufficiently as to present no toxicity problem upon discharge to the receiving waters. The overall impact of the joint project will turn into one of significant environmental enhancement.